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Geomechanics for an Underground Physics Laboratory in Alluvium

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Abstract

(Without figures)

The Lawrence Livermore (LLNL) and Los Alamos (LANL) National Laboratories of the U.S. Department of Energy perform high-energy physics experiments in an underground mine, the U1a complex, at the Nevada Test Site. The mine-operating contractor is Bechtel Nevada Corporation (BN). The peculiarity of this mine is that it is in an alluvium with an unconfined compressive strength of about 1 MPa, at a depth of 300m. So, the in-situ vertical stress is about 6 MPa. Two shafts mark the north and south boundaries of the U1a complex, the U1h (brand new) and U1a (older) shafts respectively. Their centerlines are separated by a distance of 510 m. The east-west dimension of the complex currently is about 340 m. The drifts and chambers are horizontal and have a width up to 6.6 meters and a height up to 5.1 meters, with locally larger openings at the shaft stations. The drifts are excavated using an Alpine Miner and are taken in two steps, heading and bench, or full heading. At present, ground support is by means of 2.4 m to

5.1 m long rock bolts and wire mesh, that are covered by a 7.5 to 15-cm layer of steel-fiber reinforced shotcrete applied as a dry mix.

A few years ago, some significant distress was observed in the shotcrete and the bare alluvium at several locations in the complex. In addition, significant yielding of the ground was surmised at load transfer distances of up to 60 meters. At that time, there were only a minimal number of diagnostic instruments to provide any understanding of the ground behavior. A Mining Review Board was formed in 2000, and a geomechanics program was designed and implemented to guide future expansion of the complex.

The paper describes the geomechanics results and their interpretation. Several areas are discussed:

- Strength properties of rock material; potential scale effects.
- Rock mass deformation: multi-position extensometer and closure station time-dependent data.
- Alluvium creep properties: considerable difference are shown in calculated time-constants between results of small-scale dilatometer tests and large-scale estimates based on room-and-pillar time-dependent deformation measured over several months.
- Rock load pressure cells data: these were obtained during the mine-by of a drift extension connecting the two shafts. These show load -transfer distances evolving with time.
- Rock bolt information: load cell data and pullout test results.
- Details of the ground support design.
- Results of the three-dimensional modeling of theU1a complex with a boundary element code to evaluate the potential impact of two different schemes for future mining.
- Plans for future rock mechanics studies.

The lessons of this project can provide useful guidance to underground operations in weak, creeping ground.